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SCIENCE

FRIDAY, AUGUST 27, 1920

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THE TEMPERATURE INTERVAL IN THE GEOGRAPHICAL DISTRIBUTION OF MARINE ALGÆ[1]

THE idea of geographical distribution came as a new and inspiring, although rather indefinite, concept to the German fathers of botany in the latter portion of the fifteenth and earlier portion of the sixteenth centuries. The attempt to explain geographical distribution according to the influence of environmental factors began, practically, with Alexander von Humboldt in 1805. Since his time, temperature has generally been regarded as the chief limiting factor in climatic distribution. In 1893, I called attention to the relationship existing between the position of the isotheres (mean maxima for the hottest month) of 10°. 15°, 20°, and 25° C. of the surface waters of the oceans and the limits of distribution of certain groups of kelps (Laminariaceæ). In 1894, and again in 1898, C. Hart Merriam proposed dividing the United States into certain "life-zones" or "crop-zones" according to the "summation-indices" of the temperature of the frostless season and showed the close relation of the boundary lines of these "zones," or belts as they may be more distinctly designated, to the isotheres (isotherms of mean maxima for the six hottest weeks of the season) of 18°, 22°, and 26° C. In 1913, Livingston and Livingston proposed a series of "efficiency indices" for use in plant distribution and climatology, presumably resting upon more of a physiological basis than the summations of temperature or statistical relations to various isotherms. The efficiency basis of their system is founded upon the application of the van't Hoff-Arrhenius principle as to the velocity of vital activities at different temperatures. In

[1] Delivered before the Princeton Biological Seminary on April 6, 1920.

1915 and in 1917, I brought forward additional facts bearing on the relation of the 0°, 10°, 15°, 20°, and 25° C. isotheres and added arguments for the careful consideration of the relation also of the 0°, 10°, 15°, 20°, and 25° C. isocrymes, or lines of mean minima, *i. e.*, the mean temperature of the coldest month, of the surface waters of the oceans, to the demarcation, or division, points in the marine floras.

The various writers I have just cited take up the subject of the relation of temperature to distribution almost entirely from the distributional side. They show certain, at least, of the relations of the intensity- and duration-variables in their influence on those activities of the organisms which make for persistence in the particular localities where they are to be found permanently. The activities controlled are, undoubtedly, all the necessarily vital activities of the organism, but we may feel fairly certain that those subject to the special control of the limited temperature interval are those more or less immediately connected with reproduction. In general, it may be said with some confidence, that the reproductive activties are carried on at the maxima of the temperatures at which the plant is actively and most normally performing any of its strictly vital functions. The initial temperatures, *e. g.*, those of the germination of the seeds or spores, are undoubtedly lower, in most cases at least, as are also those of most rapid growth and those of the most active metabolism. All, however, have their optima which are the temperatures connected with successful and orderly development, within comparatively narrow limits and are to be considered apart from the temperatures possibly to be endured in states of rigor, but without immediate death. Most of the physiological experiments on the influence of temperature on plants emphasize their sensitiveness as regards intensity, but do not yield many data bearing on duration effects of slightly unfavorable temperatures such as are most desirable for assisting in the solution of the problems of geographical distribution. A notable and illuminating discussion between the two different points of view is shown in the controversy between A. J. Ewart (1896 and 1898) and W. and G. S. West (1898). Ewart argues from the point of view of an experimental worker in the laboratory, testing under controlled conditions, while the Wests bring forward from their long experience in the field, seemingly discordant facts.

Phenologists are acquainted with many facts that tend to show the close relations existing between certain intensities of temperature and flowering in certain plants, particularly in fruit trees of temperate regions. Certain exotic ornamentals may live on from year to year in certain localities and never blossom. Some such may blossom in an occasional warm season, but not produce seeds, while the same species, in some sheltered and warmer spot in the same general region may flower every season and even produce scanty or abundant seed. Some plants may blossom only where the sun strikes them, on the southern side, in the northern hemisphere. In a hedgerow, the spotwise blossoming is often very noticeable and can readily be traced to insolation. I have watched such a hedge of Laburnum in Berkeley, California, in which the spots receiving the most sun blossomed out a week or more earlier than the rest. I have observed rows of *Azalea californica* in the neighborhood of the Yosemite Valley, largely shaded by tall trees, blossom only in the spots where the sun penetrated to them. Many such instances might be evidenced, but the resultant inference is the same. Lloyd (1917) has recorded his observations on the "Critical flowering and fruiting temperatures for *Phytolacca decandra*." At Tucson, Arizona, this species produces flowers and seeds in abundance, but at Carmel, California, a locality of decidedly lower temperature maximum, it fails to do so, although, otherwise, it grows well and apparently normally. Plants grown in a small glass shelter at Carmel, however, produced an abundance of flowers, fruits and perfectly viable seeds. In one or two instances single branches of plants without the shelter, but in sheltered positions, also bore seeds. As a result of

temperature readings under the different conditions, Lloyd came to the conclusion that raising the temperature not over 5° F. would be sufficient to produce normal flowering at Carmel. M. Moebius (1897) has treated of the matter of temperature in his "Beiträge zur Lehre der Fortpflanzung der Gewächse" and brings forward many authenticated cases of the effects of changes of temperature on the flowering and fruiting habits of plants. He calls attention to the fact that plants provided with effective methods of vegetative multiplication, such as the members of the Lemnaceæ, may occur in abundance in cooler regions, such as Central Europe, but seldom or never (Wolffia) fruit, while they bloom and fruit abundantly in warmer regions where they are equally common. The difference in temperature in these cases is partly of greater intensity, although presumably not considerably, partly also of duration of the higher intensity.

It seems to me that it is this narrow interval of temperature which separates the carrying through of reproductive processes from their inhibition, that is indicated by correspondingly narrow temperature interval between the isotheres and isocrymes which seem to delimit so accurately the different floras from one another. From the physiological point of view, there seems to be indication that the optima of effective reproduction which makes for persistence in distribution, lie within an interval of 5° C., an interval surprisingly narrow. The controlling influence of this narrow interval, however, so far as the persistence of the various species in any zone or zones is concerned, seems well substantiated by the various tabulations and critical examination into seemingly exceptional cases which I have made and published elsewhere. The overwhelming majority of the known marine algæ of the world are recorded from only one zone. A considerable number are said to occur in two zones, a very few in three zones and a very small percentage in four or five zones. It seems, therefore, fairly certain that the normal interval is one zone of 5° C. amplitude and that the invasion of other zones than the normal is due to the existence in the invaded zones of temperatures of the same intensity and duration found in the normal zone. This has been shown in a sufficient number of cases to indicate that it is to be looked for as a general rule.

There is another interval besides that mentioned above, which has more or less to do with the life, normal and invading, of any particular zone and that is the interval of amplitude of seasonal variation in temperature in each zone. There may be certain portions of the tropical zone in which there is little, if any, seasonal change of temperature. In certain portions of the oceans, free from currents of a strongly influencing nature, the isocrymes and isotheres 5° C. apart are very nearly superposed and it seems logical to assume that this seasonal interval is normal. The extreme interval in portions of zones thus affected is, therefore, 10° C. in amplitude, the interval between extreme mean maxima and mean minima estimated from monthly variations. This interval, viz., 10° C., may be assumed to be the interval of optimum temperatures for persistence and including all actively vital processes of the particular species normal to any zone. There are regions in some zones, however, where the mean seasonal variation alone amounts to 18° or 20° C. It is undoubtedly a fact that where the seasonal interval is large and particularly where it is much greater than 5° C., the species normal to the zone pass the colder portion of the season in a state of quiescence, or rigor, either in the vegetative or in the seed or spore stages of development. In the colder seasons of any region of a zone suffering a considerable seasonal interval, the invading species from a lower zone are to be found in vegetative and reproductive activity and pass into a condition of quiescence when the temperatures characteristic of the zone prevail, a sort of heat rigor. As a result of the extreme seasonal variation in temperature of the northeastern coast of North America, for example, *Ascophyllum nodosum*, one of the rockweeds or Fucaceæ, whose normal zone is the region of Greenland in the upper boreal zone and where it develops its vegetative body

and fruits abundantly in summer and below the isothere of 10° C., extends south to the northeastern coast of New Jersey where it develops and fruits at the winter and spring temperature of 5° C., but is sterile and evidently quiescent at the summer temperature of 22° C. Since it is a perennial species, it is to be found in the southern portions of its range among the summer subtropical species of the Long Island Region and this is extremely misleading until the conditions of its existence south are understood. When these are made clear, it stands out as a conspicuous and convincing example of the narrow interval of temperature making for persistence.

Connected with these narrow intervals seeming to control persistence in certain groups of species of marine algæ and limit their distribution, there is associated the observed fact that the 10°, 15°, 20°, and 25° C. isotherms of the surface waters sharply mark off the life-zones from one another. This conclusion comes as a result of the critical study of the relations of these isotherms to certain well-known division points, or demarcation areas, between distinct floras. In a recent study of the relation of Cape Cod to the floræ of the New England coast, where I had at hand detailed information of greater abundance, variety and accuracy than it is generally possible to obtain about such matters, I found that the isothere of 20° C. certainly seemed to divide very sharply the northern species as to their distribution, from the southern. The details of this investigation will be published elsewhere, as it is unnecessary to go into them here, but I desire to mention one which will emphasize the point I am trying to make evident. At the entrance to Vineyard Sound, between Gay Head on Martha's Vineyard and Sow and Pigs off the southern end of the Elizabeth Islands, as Sumner and Davis (1913) have shown in various charts, the surface temperatures in summer are slightly above and the bottom temperatures are slightly below 20° C. and the southern species are found in the surface waters, while the northern species inhabit the depths. This, it must be remembered, is only one example of a considerable number which might be cited, to show how abruptly species stop or start in their distribution at one or another of these isotherms. The marine algæ extend slightly below 0° C. Thus far I have not been able to determine satisfactorily the conditions at the 5° C. isothere, but the 5° isocryme seems possibly a limiting line. There can be no question, as it seems to me, but that the isotherms, both isotheres and isocrymes, of 10°, 15°, 20°, and 25° C. definitely limit the extension of particular floras of marine algæ and that too, very sharply and exactly.

The explanation of the narrowness of the temperature interval seemingly, at least, of such paramount influence in controlling distribution, is by no means clear. If we lay stress on the interval of 5° C. which seems to control reproduction, we have no physiological basis at present apparent. If we consider the probability that the normal interval of each zone and its peculiar flora, is 10° C., then we may perhaps feel inclined to suggest that each marine algæ may persist up to the point where its initial vital activities, in accordance with the working of the van't Hoff-Arrhenius principle, may be doubled in velocity, but no more. In case this may be the proper explanation, the interval of 10° C. seems to be more exact and regular than it has been found to be even as determined for purely chemical reactions. Possibly the temperature intervals may have to do with the varying viscosities of the sea-water or its power to dissolve gases such as oxygen or carbon dioxide. On the other hand, it may have to do with the activities of some particular enzyme or group of enzymes which act effectively, as these are known to do, only within narrow limits of temperature. I feel, therefore, that I can do little more at the present time, than to lay emphasis on the narrowness of the interval and the seeming importance of the maximum and minimum isotherms very closely approximating 5° C. apart.

William Albert Setchell
University of California

A THIRD CAPTURE ON THE FLORIDA COAST OF THE WHALE SHARK, RHINEODON TYPUS

ON June 11, 1919, a telegram was received at the American Museum of Natural History announcing the capture on the preceding day near Miami, Florida, of a 31-foot *Rhineodon* and asking if the museum wanted it for a specimen. Since it was too late to have the soft parts preserved, a message was sent making an offer for the head, gill rakers, fins, tail, and backbone, but no answer was returned.

This specimen of the whale shark was taken June 10, 1919, in the Bay of Florida near Man-of-War Key about eight miles southeast of Cape Sable. Information concerning its capture has been difficult to get (the latest account reaching me only recently), but the accounts agree that this great shark, which when first sighted looked like a piece of wreckage, was aground in about five feet of water, the center of the body on the shoal but the head and especially the tail fairly free, while the back extended about a foot above water. About a hundred bullets were fired into the shark before it finally succumbed. Holes were then cut in the skin and ropes run through these to hold the body fast when the tide rose. It was then towed to the mouth of the canal at Florida City and there skinned and the jaws taken out. Unfortunately, neither the gill-rakers nor the vertebræ were saved.

To Dr. H. Schlegel, one of the captors, I am indebted for two photographs showing the skinning, and for another in which the fish is seen lying somewhat on one side in the water alongside the wharf. This picture shows the gill slits, the dorsal ridge extending back to the first dorsal fin, the broad back from which the vertical stripes have faded, and most important of all, the lateral keel on the caudal peduncle which is such a marked feature in the description of the original discoverer, Dr. Andrew Smith.

As to size, this specimen of *Rhineodon* was said to measure 31 feet and some inches long. The body was about eight feet wide, and the mouth about five feet across. The eye is described as being as large as a base ball, but having a pupil about the size of the eye of a child. It is greatly to be regretted that there was no scientifically trained person at hand to make careful measurements and give an accurate description of this specimen. The above figures are, however, believed to be substantially correct. The weight was estimated to be about nine tons, which is probably an excessive figure.

The skin has been purchased by Mr. Arthur D. Lord, of New York, and presented to the American Museum of Natural History. It is planned to have the skin mounted, or more probably a cast made. This will be the only mounted specimen in any museum in the new world. In the old world there are specimens in the British Museum, the Paris, Madras, Colombo (Ceylon) museums, and one in the hands of a private dealer in curios in Japan. In this country there is a skin in the United States National Museum and a mounted specimen in Miami, Florida.

This is the third capture in Florida waters of *Rhineodon typus*. The first, a small specimen 18 feet in length, came ashore at Ormond, Florida, in 1902. The second specimen was taken by Captain Charles Thompson, of Miami, and Mr. Charles T. Brooks, of Cleveland, Ohio, toward the close of May, 1912. This fish measured 38 feet long and about 18 feet in circumference, and Mr. Brooks estimated its weight at five tons, while Captain Thompson thought it would weigh three time as much. Captain Thompson had this specimen mounted and placed on exhibition in Miami.

It is significant that two of the three Florida specimens have been taken in localities not more than thirty to forty miles apart, while the third, although it came ashore some distance further north, was evidently carried there by the Gulf Stream. Further it is interesting to note that one specimen was found dead, and that the other two put up fights for liberty by no means in correspondence with their immense size and strength. Mr. L. L. Mowbray, Director of the Miami Aquarium, from certain

information which has come to him from fishermen who ply their trade out in the Gulf of Mexico, thinks that near the center of the Gulf these great fish have a breeding ground, and that they are fairly abundant.

These sharks are most abundant around Ceylon, in the East Indies around Java, north among the Philippines and to the coasts of Japan. Recently a new habitat record in this region has been noted. Mr. J. Dewar Cumming, in his book "Voyage of the Nyanza . . . in the Atlantic and Pacific [Oceans]," London, 1892, says that at Hillsborough Island, the largest of the Coffin or Bailey group, in the Bonin Archipelago, he saw a whale shark, which ". . . must have measured 25 to 30 feet in length, and was at least eight feet across the shoulders. The color was of a bluish-gray, dotted with large white spots."

Rhineodon is, however, found most frequently around the Seychelles Islands in the western Indian Ocean, about midway betwixt the equator and the northern end of Madagascar. In 1914–15, an expedition was planned for the Seychelles to study *Rhineodon,* but had to be postponed on account of the great war. With the coming of peace, plans were again made, but in the face of the enormous rise in the cost of transportation, of living expenses and all commodities, another postponement has been necessary. In the meantime a correspondent at Mahé, Seychelles Islands, writes that *Rhineodon* is more plentiful there than ever.

For fuller information (in fact everything known) about this great fish, references may be made to papers by the writer previously published elsewhere.[1]

E. W. Gudger
American Museum of Natural History,
New York City

[1] "Natural History of the Whale Shark, *Rhineodon typus* Smith.," *Zoologica,* Scientific Publications New York Zoological Society, 1915, Vol. 1, pp. 349–389, 12 figs. "*Rhineodon typus,* the Whale Shark: Further Notes on its Habits and Distribution," Science, 1918, N. S., Vol. 48, pp. 622–27.

SCIENTIFIC EVENTS

THE SPAWNING GROUNDS OF THE EEL

The Bureau of Fisheries reports that Dr. Johannes Schmidt, a distinguished Danish scientist, has recently completed an exploring voyage across the Atlantic in the steamer *Dana,* of the Danish Commission for Marine Investigation. Dr. Schmidt, who is director of the Carlsberg Laboratory in Copenhagen, for about 15 years has been devoting special attention to the fresh-water eels of Europe and America, and is the leading authority on these interesting fishes, which are relatively much more important in western and southern Europe than in eastern America. Dr. Schmidt has made important contributions to the sea life of the eels, and during the recent cruise from Gibralter to Bermuda and the West Indies collected large numbers of larval eels, with a view to determining the spawning grounds of the European and American eels, which represent distinct but closely related species. Dr. Schmidt says:

> I think I am now able, after so many years' work, to chart out the spawning places of the European eel. The great center seems to be about 27° N. and 60° W. [southwest of Bermuda], a most surprising result, in my opinion. The American eel seems to have its spawning places in a zone west and south of the European, but overlapping. The larvæ of both species appear to pass their first youth together, but when they have reached a length of about 3 centimeters the one species turns to the right, the other to the left.

The assistance of the Bureau of Fisheries is invoked by Dr. Schmidt in obtaining further specimens of larval eels taken from waters off the American coast south of Cape Hatteras in sumer and autumn; most of the collections heretofore made in that region have been in winter when few eels are spawning.

AGRICULTURAL WORK AT THE UNIVERSITY OF NANKING

The latest annual report of the college of agriculture and forestry of the University of Nanking, China, as abstracted in the *Experi-*

ment Station Record, reports the progress made at this institution in the development and extension of its agricultural work. One of the events was the organization, late in 1918, of an agricultural experiment station. This action followed a recommendation by Professor C. W. Woodworth of the California University and Station, who was then temporarily serving at the college as special investigator and lecturer on entomology. Subsequently, several tracts of land, aggregating about 21 acres, were purchased at a cost of $9,000. About 5 acres have already been planted to mulberries for sericultural work, and the remainder is under general cultivation. The college also has the use of about 36 acres of vacant university land, though the small size and scattered nature of the various holdings constitute a serious handicap to experimental work. It is estimated that eventually at least 160 acres of adjacent land will be needed for the college farm and station.

Much of the principal work so far under way has dealt with sericulture. About $5,000 has been provided for this by the International Committee for the Improvement of Sericulture in China. The chief undertaking of the committee is to produce certified silk worm eggs by the Pasteur process and distribute them to farmers, studies at the college indicating an average incidence of disease of 66 per cent. for uncertified stock. This work was temporarily interrupted by fire, which destroyed the entire product for the year. The college is also grafting 100,000 mulberry trees for sale at cost in 1921 and 150,000 for 1922, and is carrying on experiments in the production of mulberry cuttings and studies in pruning, fertilization, culture, etc. Tests are being made on the utilization of the autumn crop of mulberry leaves, as well as breeding and selection work with silk worms. A three-month course in sericulture has been instituted, and extension work through lectures and demonstrations is contemplated.

Cotton experiments have already shown that certain foreign varieties can be successfully grown in China, though careful tests are necessary to determine the adaptability of varieties to diverse conditions. A cooperative test was organized in 1918 in eight provinces with pure seed of the standard test sets of the U. S. Department of Agriculture. The cotton improvement work is being supported by two Chinese cotton mill owners' associations and the Shanghai Anti-Adulteration Association.

Improvement of native corn by pedigree selection has been carried on for four years, and seed distribution to farmers is to be begun this spring. There has also been selection work with about 75 strains of lowland rice, 100 native and foreign strains of wheat, and about 100 varieties of fruits.

There is much interest in forestry, and about 7 acres of land are devoted to forest nurseries. A colonization project on Purple Mountain has largely developed into a reforestation demonstration.

The student enrollment has numbered about 100, of whom 42 were regular students in agriculture, 30 in forestry, and 26 in the short course of sericulture. The demand for trained graduates has exceeded the supply, notably for assistants for agricultural missionary work. There has been a marked increase in interest on the part of missionary organizations and also by a number of influential government officials.

ALL-AMERICAN CONFERENCE ON VENEREAL DISEASES

AN All-American Conference on Venereal Diseases will be held in Washington, D. C., December 6 to 11, 1920. It is under the auspices of four organizations—

The U. S. Interdepartmental Social Hygiene Board, represented by its executive secretary, Dr. Thos. H. Storey.

The U. S. Public Health Service, represented by Assistant Surgeon General C. C. Pierce.

The American Red Cross, represented by its president, Dr. Livingston Farrand, and

The American Social Hygiene Ass'n., represented by general director, Dr. Wm. F. Snow.

The conference will deal with both administrative and research problems, and will consider the attack on venereal diseases from four different aspects:

(1) Medical Measures,
(2) Enforcement of repression and protection laws,
(3) Sex Education and
(4) Provision of Recreational facilities.

Dr. William H. Welch, of Johns Hopkins University, is president of the conference.

An attempt will be made to work out a feasible three-year program for each of the countries of the western hemisphere. Preliminary organization is in charge of Paul Popenoe. Headquarters of the conference are at 411 Eighteenth Street, N.W., Washington, D. C.

DYE DIVISION OF THE AMERICAN CHEMICAL SOCIETY

The Dye Division of the A. C. S., which had its inception first as a Dye Symposium then as a Dye Section, is now a duly organized part of the American Chemical Society. The division is undertaking to carry on regular and systematic work for the benefit of the dye industry of America in general; and the users of dyes, manufacturers of dyes, and dye chemists in particular, laying, of course, its especial emphasis upon the chemistry of dyes and dyeing.

It is the duty and the privilege of every chemist in America, who is interested in the chemistry, manufacture, or use of dyes, to enroll himself as a member of the American Chemical Society and its Dye Division, to attend and participate in the semi-annual meetings. The advantage will be mutual, both to the members and to the industry.

To enroll yourself in the division, write to the secretary, and also inform him if you have ready for presentation any paper on the manufacture or application of dyes and intermediates. Enclose the sum of $1.00 as dues for 1920. The dues are for the expenses of the division, consisting mainly of postage and stationary. It is planned as soon as funds permit, to compile and distribute a directory of dye chemists who are registered in the Dye Division of the A. C. S.

The next meeting of the Dye Division will be at the fall meeting of the American Chemical Society, to be held in Chicago September 7 to 10, 1920. At that time it is expected that a number of dye concerns will come forward with papers of intensive scientific interest.

There has been some considerable feeling in the past that the concerns should keep all their research work secret, and that none of it could be revealed at such meetings without detriment. However, since every research laboratory turns out a large amount of work which is of very great scientific interest to the trade in general but may have no specific bearing on any process in particular, we may expect that a large number of papers will be presented of such a nature as to demand the attention of every dye laboratory.

Please plan to attend this meeting and inform the secretary of the title of any paper pertaining to the dye industry that you will have ready for presentation.

R. Norris Shreve,
Secretary
43 Fifth Avenue,
New York City

THE FEDERATED AMERICAN ENGINEERING SOCIETIES

The following invitation is being sent to engineering and allied technical organizations, asking them to become charter members of The Federated American Engineering Societies.

The joint conference committee of the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers, acting as the ad interim committee in accordance with the authorization of the organizing conference held in Washington, D. C., June 3–4, 1920, extends to your organization a cordial invitation to become a charter member of The Federated American Engineering Societies, and to appoint delegates to the first meeting of the American Engineering Council, of which due notice will be given, to be held in the fall of this year.

There has been previously sent to you an abstract of the minutes of the organizing conference, at which there were in attendance 140 delegates, representing 71 engineering and allied technical organizations. It was the unanimous opinion of

the Conference that there should be created an organization "to further the public welfare wherever technical knowledge and engineering experience are involved and to consider and act upon matters of common concern in the engineering and allied technical professions" and that this organization should consist of societies or affiliations, and not of individual members.

On the basis of these fundamentals, the attached constitution and by-laws were unanimously adopted by the conference. These contain full information concerning The Federated American Engineering Societies, the American Engineering Council, its executive board, and of the various officers and committees. The basis of representation therein stated for the American Engineering Council is one representative for from 100 to 1,000 members and an additional representative for each 1,000 members or major fraction thereof.

At the gathering in Washington, which was the greatest event in the history of the engineering and allied technical organizations in this country, steps were taken which created "The Federated American Engineering Societies," which will have a far reaching influence on the future of these professions. The fact that this action was taken without a dissenting vote indicates that the psychological moment had arrived and that there was a unanimous desire on the part of the representatives of these professions for the organization formed.

The joint conference committee, the ad interim committee would ask each organization invited to take favorable action in the matter of membership in the organization at the earliest possible moment and to advise the committee promptly of the names of the delegates who will attend the first meeting of the American Engineering Council in November of this year.

The joint conference committee is confident that with the universally acknowledged need for such an organization, there will be a prompt affirmative response to this invitation.

SCIENTIFIC NOTES AND NEWS

SIR NORMAN LOCKYER, director of Solar Physics Observatory, London, and editor of *Nature* from its establishment over fifty years ago, died on August 16 at the age of eighty-four years.

ON the occasion of the meeting of the British Association at Cardiff this week the University of Wales proposed to confer the honorary degree of D.Sc. on Dr. H. F. Osborn, president of the American Museum of Natural History, or, if he is unable to attend, Professor C. A. Kofoid, University of California; Professor G. Gilson, University of Louvain, or, if he can not attend, Dr. C. H. Ostenfeld, University of Copenhagen; Don Gullermo Joaquin de Osma, Madrid; and Professor Yves-Guyot, Paris.

DR. IRVING FISHER, professor of political economy at Yale University, has been elected president of the Eugenics Research Association.

PROFESSOR FREDERIC S. LEE, of Columbia University, and Professor Graham Lusk, of Cornell Medical College, were recently elected members of the board of the Institut Marey of Paris.

DR. G. C. SIMPSON, F.R.S., meteorologist to the government of India, has been appointed director of the British Meteorological Office as successor to Sir Napier Shaw, who retires on reaching the age-limit.

DR. HENDRIK J. VAN DER BIJL, who has for the past seven years been in charge of researches in thermionics and in vacuum tube operation at the Research Laboratory of the Western Electric Company, Inc., sailed on August 4 for Pretoria, South Africa, where he has been appointed scientific and technical adviser to the Department of Mines and Industries of the Union of South Africa.

N. H. BOWEN has resigned his professorship in Queens University, Kingston, Canada, and has rejoined the staff of the Geophysical Laboratory of the Carnegie Institution of Washington.

THE board of scientific directors of the Rockefeller Institute for Medical Research announces the appointment of Edric Brooks Smith, B.S., as business manager, and Frederick Stanley Howe, A.B., as assistant business manager.

H. W. VAUGHAN, professor of animal husbandry in the University of Minnesota, has resigned to become one of the editors of the *Duroc Digest*.

Mr. Charles W. Trigg, who has been engaged in research on coffee at the Mellon Institute for the past four years, has taken charge of the technical department of the King Coffee Products Corp., Detroit, Mich. Mr. Trigg will remain a senior fellow of the institute.

Dr. Irving Hardesty, professor of anatomy in the school of medicine, Tulane University, has been granted a leave of absence for 1920–1921, which he will spend at the University of California.

Whitman Cross, E. E. Larsen and C. P. Ross, of the U. S. Geological Survey, have spent the summer field season in the southern part of the San Juan region, Colorado.

Charles T. Kirk, of Tulsa, Oklahoma, has spent five months as economic geologist in Colombia and other Spanish-American countries.

Dr. Stephen S. Visher, assistant professor of geography, Indiana University, has been granted a semester's leave and is now in Europe. He is working on the problem of contributions to civilization, with special reference to Spain, France, Ireland and Scotland.

H. Foster Bain has been making geological examinations in Yunnan, southern China.

Professor Homer R. Dill, director of the vertebrate exhibit in the museum of the University of Iowa, is in charge of an expedition to Honolulu. Upon returning to the United States in October, Professor Dill will lead a party to the region on the border between Washington and British Columbia where collections will be made for the museum.

Mr. William L. Finley has been commissioned by the National Geographic Society to secure motion pictures of the rarer birds and mammals of North America. Mr. and Mrs. Finley have visited Arizona and the Gulf Coast of Texas, in the pursuit of this work.

Dr. Frederick Starr, associate professor of anthropology in the University of Chicago, is giving three illustrated lectures at the university on August 25, 26 and 27. The subject of his first lecture will be "The Nosatsu Kai," of the second "Ema," and of the last, "The Ascent of Mount Fiji." Professor Starr returned a few months ago from anthropological researches in Japan and Corea.

We learn from *The Condor* that the National Parks Service this year inaugurated a system of instruction in natural history for visitors to Yosemite National Park. Through cooperation with the California Fish and Game Commission, Dr. H. C. Bryant gave instruction from June 1 to August 31. Dr. L. H. Miller, department of biology, Southern Branch, University of California, was in Yosemite during part of the summer and toward the end of the season he conducted similar work at Fallen Leaf Lake, in the Tahoe region. The programs include lectures on the plant and animal life of the mountains, to be illustrated in part by lantern slides and moving pictures. Field trips will be arranged for parties of different ages.

The Civil Service Commission announces an examination for naturalist in the Bureau of Fisheries for duty on the steamer *Albatross*, at $2,200 a year. Applicants must have graduated from a college or university of recognized standing and have had at least two years' experience in biological or hydrographic. investigations.

The *Bulletin* of the American Mathematical Society states that Gustav Foch, of Leipzig, offers for sale the library of the late Professor Moritz Cantor, of Heidelberg, the historian of mathematics. The library consists of about 2,000 volumes and 2,500 pamphlets.

New laboratories for research on the origin and treatment of tropical diseases were opened at Liverpool on July 24 by Lord Leverhulme. The laboratories are named after Sir Alfred Jones, the Liverpool shipowner, who took a great interest in the pioneer work done in the investigation of tropical diseases at Liverpool, and made provision in his will for the erection of a laboratory and for the buildings in which the work had hitherto been carried on.

The second International Congress of Comparative Pathology will be held at Rome in the spring of 1921 under the presidency of Professor Perroncito. Communications should be

sent to the secretary, Professor Mario Tevi Della Vida, via Palermo 58, Roma.

THE Faraday Society and the Physical Society of London have arranged to hold a general discussion next October on colloidal physics and chemistry.

THE thirty-ninth annual meeting of the Society of Chemical Industry was held at Newcastle-upon-Tyne on July 13–16. The gold medal of the society was presented to M. Paul Kestner, president of the Society of Chemical Industry of France. Sir William J. Pope was elected president for the ensuing year and an invitation to hold the next annual general meeting at Montreal was accepted.

THE *Scientific American* is offering $5,000 for the best essay of 3,000 words explaining the Einstein theory. All essays must be in English and written as simply, lucidly and non-technically as possible. They must be typewritten and must reach the office of the *Scientific American,* 233 Broadway, New York, by November 1, 1920. The right is reserved to divide the prize between two contestants if in the opinion of the judges the best two essays are of equal merit.

THE *Journal* of the American Medical Association records the appropriation by the Swedish government of 5,000 crowns to aid the Swedish Medical Association in publishing three journals, the semimonthly, quarterly and transactions. Three journals devoted to hygiene are given from 1,000 to 1,500 crowns, and four specialist journals from 500 to 1,200. To aid in starting the new *Acta Oto-Laryngologica,* 4,000 crowns are appropriated. Each of the journals specified is to donate a number of copies to the university libraries.

IT is reported from Paris that the mosquito plague was so serious there last year that the Pasteur Institute has been devoting special attention to the destruction of the larvæ. An old plan was to pour oil on the waters where mosquitoes breed, but this also killed any fish there might be in the waters, besides making it unfit for drinking. M. Roubaud, of the Pasteur Institute, has now discovered a method of destroying the larvæ by sprinkling powdered formaline on the surface of the water. It is said that this does not injure fish or make water impossible to drink, and is more rapid and effective than oil.

THE gift of a collection of fossils and shells which makes the University of Illinois collection of fauna and flora representing the coal period the largest extant was announced at the recent meeting of the trustees of the university. The collection was made by J. C. Carr.

UNIVERSITY AND EDUCATIONAL NEWS

THE family of the late Sir John Darling, of Adelaide, South Australia, have contributed the sum of £15,000 towards the cost of erecting a new building for the medical school of the University of Adelaide. This building will be designed to accommodate the departments of physiology, biochemistry and histology and the medical library. The building will be erected and equipped at a cost of £25,000.

MR. WALTER MORRISON, of Balliol College, Oxford, has just paid to Bodley's librarian the sum of £50,000 for the capital account of the library. Mr. Morrison had previously given £10,000 to each of three university funds—one for the readership in Egyptology, another for the promotion of the study of agriculture, and a third towards the establishment of a professors' pension fund.

PRELIMINARY plans have been made for an International University, which will hold its first session in Bruxelles from September 5 to 20. The courses cover practically the whole field of higher education, but will lay special weight on questions of current interest. They will be given in the building of International Associations, and there will at the same time be held a number of congresses and meetings. The names of those who will give the courses are not announced in the preliminary program, issued in July.

DR. R. I. WOLD, for the past five years connected with the engineering department and

the research laboratories of the American Telephone & Telegraph Company and the Western Electric Company, has accepted the position of head of the physics department at Union College and will cooperate with the research laboratories of the General Electric Company in certain research work.

Professor James T. Rood, of the University of Illinois, has been appointed professor of electrical engineering at the University of Wisconsin. Professor Rood was graduated from the Worcester Polytechnic Institute in 1898 and obtained the degree of doctor of philosophy at Clark Institute in 1906. He taught nine years at Lafayette College and has since been two years on the Illinois faculty.

Fred C. Werkenthin, associate professor of botany in New Hampshire College, has been elected to an instructorship in botany in Iowa State College.

Dr. G. R. Bisby, formerly of the University of Minnesota, has accepted the position of professor of plant pathology at the Manitoba Agricultural College, Winnipeg, Canada.

Professor J. T. Wilson has been elected dean of the faculty of medicine in the University of Sydney in succession to the late Sir Thomas Anderson Stuart.

DISCUSSION AND CORRESPONDENCE

METHODS USED IN THE STUDY OF SOIL ALKALI

In Science of February 6, 1920, Mr. F. B. Headley, of Fallon, Nevada, took occasion to call attention to imperfections in methods of studying soil alkali used by the Utah Station and some other institutions. His criticism seems to center around two ideas: (1) that we consider that salts added to the soil represent the true concentration of the soil solution; (2) that we did not analyze soils to which salts had been added and that we were therefore entirely ignorant of the amount of alkali the soil contained.

Answering these in order, I may say that in Utah we have never considered salts added to the soil to be anything but *salts added.* Workers in soil science are fully aware of the fact that when such salts as carbonates are added to the soil they immediately undergo transformations that are not well understood. No one, so far as I know, would undertake to tell just what the soil solution as it affects plants really is. It is somewhat like trying to tell the composition of living protoplasm. As soon as an attempt is made to analyze the protoplasm, it is killed and its composition is probably changed. Numerous methods for arriving at the concentration of the soil solution have been suggested. These include (1) direct chemical analysis of leachings of the soil, (2) subjecting the soil to high centrifugal force in an attempt to throw off some of the real soil solution, (3) placing the moist soil under very heavy pressure to press out some of the solution, (4) attempting to obtain the osmotic pressure of the soil, (5) obtaining the conductivity of the soil to a current of electricity, (6) determining the concentration of salts by the lowering of the freezing point, and (7) getting the vapor pressure of the soil in order to determine the concentration of the soil solution.

None of these methods has been entirely satisfactory, but each one has been useful in connection with certain studies. I think it can be said therefore that at present we have no means of measuring the exact concentration of the soil solution as it affects plants. Neither the amount of salt added to the soil nor the amount recovered by chemical analyses represents the true value, and in making any interpretation it is necessary to state specifically in each case whether reference is made to "salts added" or "salts extracted." At the Utah Station we have been very careful to say which of these we referred to in every case.

In a recent publication (Utah Station Bulletin No. 170) we have taken occasion to show the relation of "salts added" to "salts recovered" by extraction using various quantities of water and stirring for different lengths of time, by the freezing point method,

and by the conductivity method. It is evident from these results that in discussing the toxic limits of alkali it will be necessary to state the method used, the same as in discussing the amount of phosphoric acid in the soil it is necessary to say whether the soil was extracted with weak citric acid, weak hydrochloric acid, or fused. The result will vary with the method of extraction.

Mr. Headley mentions several times that we have made no analyses and consequently we do not know what the soil contains. As a matter of fact, we have made thousands of analyses of soils after adding salts to them as well as soils direct from the field. In one of the papers mentioned by him[1] we have given four tables aggregating about 650 determinations to show the relation of "salts added" to "salts recovered" by extraction and as determined by depression of the freezing point.

In Utah Station Bulletin No. 170 we have given the following table:

TABLE I

Percentages of Salt Added to Soils Determined by Water Extraction

NaCl Added (p.p.m.)	No. of Samples	Mean Per Cent. Extracted	Prob. Error in Per Cent of Mean	Na_2CO_3 Added (p.p.m.)	No. of Samples	Mean Per Cent. Extracted	Prob. Error in Per Cent. of Mean	Na_2SO_4 Added (p.p.m.)	No. of of Samples	Mean Per Cent. Extracted	Prob. Error in Per Cent. of Mean
		(p.p.m.)			15	(p.p.m.)				(p-p.m.)	
None	15	(196.3)	21	None	15	(727.8)	35	None	15	(454.4)	36
200	15	193.7	44	500	15	169.8	29	500	15	172.9	20
400	15	123.0	13	1000	15	95.9	25	1000	14	141.8	23
600	15	109.4	11	2000	15	58.5	19	2000	15	123.7	16
800	15	107.2	8	3000	15	57.0	15	3000	15	119.3	12
1000	15	108.2	12	4000	15	51.7	10	4000	15	115.0	14
1500	15	102.9	10	5000	15	51.1	15	5000	15	111.4	16
2000	15	102.7	8	6000	15	50.4	36	6000	15	113.3	13
2500	15	104.3	12	7000	15	48.5	17	7000	15	115.7	12
3000	15	99.8	5	8000	15	49.3	38	8000	15	119.5	16
3500	15	97.1	6	9000	15	50.3	14	9000	15	111.0	13
4000	15	95.3	8	10000	15	49.1	13	10000	15	108.1	11
Average		113.0	13			66.5	21			122.9	18

This table shows that practically all of the chlorids and sulfates added could be recovered by leaching. In the lower concentrations additional salts, which were originally present in the soil, were recovered. In the case of the sulfates very much more was recovered than was added. This came largely from calcium sulfate which was present in the soil and which was leached out by the comparatively large quantities of water used in extracting the soil. In the soil itself the calcium sulfate is not sufficiently soluble to cause injury to plants; hence, it should be subtracted from the total sulfates obtained. In the case of the sulfates the "salts added" are doubtless a more reliable index to the real concentration of the soil solution than the "salts recovered."

With the carbonates it will be seen that only a part of the salts added could be recovered by extraction. This means that in the case of carbonates a correction factor must be used for the "salts added," although this in many cases is probably just as satisfactory as to use "salts recovered."

Even though we have in all our work had available data on "salts recovered," we have in many cases preferred to indicate the concentration by "salts added," since the former method of expression is open to some rather serious objections which it is probably unnecessary to point out here.

We hope that this will clear up any misunderstanding of our work, for we believe that while "salts added" does not tell the

[1] *Journal Agricultural Research*, Vol. 15, pp. 287–319.

whole story, still it is a very convenient and useful way of indicating the alkali condition of the treatment that is under investigation.

F. S. Harris
Utah Agricultural Experiment Station,
Logan

THE RÔLE OF PSYCHOLOGICAL FACTORS IN DIGESTION

An experimental report on the relative digestibility of palatable and unpalatable food in a recent number of Science by Messrs. Holder, Smith and Hawk,[1] raises the important problem of the place of the mental factors in such activities of the human being as the partaking of food. In a general way this is the problem of the unified and complete versus the partial functioning of the organism. Now the title of the report in question, namely, "Is Unpalatable Food Properly Digested," clearly indicates that the question of the partial or incomplete functioning of the organism is in point here. For the question of palatableness is one which concerns not merely the comparatively simple, metabolic chemical reaction, but always involves a highly integrated conscious organism such as a human individual.

When we study isolated phases of an organism rather than observe the responses of the organism as a whole, we naturally arrive at different results, and so the report based upon isolated physiological data reads as follows: "If the stomach and intestine can be cajoled into making the proper effort, the unsavory concoction can be digested just about as satisfactorily as can the food mixture which makes a stronger appeal." This conclusion is reached by the observation that there is only one per cent. difference in the utilization of nitrogen when taking palatable and unpalatable food.

At this point appear some questions of extreme importance. For example, has there been sufficient time in the two days in which the unpalatable food has been adminstered for any change to take place in the functioning of the organism? Would not a protracted period of subjection to unpalatable food conditions show marked metabolic deterioration? It is decidedly an open question how long the stomach and intestine can be cajoled into making the proper effort for digestion when the organism (person) perceives and objects to the disagreeableness of the food. Indeed the writers declare that this experiment "shows how insulting we can be to the normal stomach and get away with it, but this does not necessarily prove this to be the wisest policy." Why should there be any question of policy? The answer is clear; the student of psychopathology knows full well what are the dangers of being compelled to respond to food or other situations under unfavorable circumstances. The record of broken-down organisms with incapacitating digestive symptoms is too large to leave any room for doubt as to what hygienic policy should prevail with respect to the palatableness as well as other conditions of the food-taking responses. Further, aside from the too brief period employed in the experiment, one must not lose sight of the fact that the subject was fully cognizant of responding to an experimental situation, a fact which greatly influences the stimulus-response complex.

When we consider the digestive functions as isolated activities of the organism it is beyond dispute that the absorption and utilization of the materials will depend essentially upon the chemical constitution or the food value of the materials eaten, but can we so consider human digestion? To consider digestion or any other organic process as an abstract activity is to overlook entirely the unitary character of a biological organism. Of course, no one can possibly fail to observe the value of the hypothesis that the complex activities of organisms are rather simple chemical reactions, for upon no other basis could progress be made in the investigation of such phenomena. But, this in no wise implies that in order really to understand the organism we must overlook the functioning of it as a whole. And when we do study the organism as a unit we not only find that "psychic stimuli" promote or retard the secretion of

[1] LI., p. 299.

digestive juices, but that all actions of the individual are affected by the particular surrounding conditions of such actions.

That unfortunate effects result from the failure to appreciate the fact that in dealing with the human organism we are not dealing with isolated elements is a common observation in medical practise. All too frequently an individual, who is clearly in the process of preventable disintegraton, is caused to break down completely because the elemental theory actuates the psychiatrist to pronounce that there is nothing wrong with a person having no apparent organic or functional lesion. The writer wishes to suggest, that at least from a medical standpoint, we have placed too great emphasis upon the chemical factors in the process of human digestion and too little stress upon the psychological factors.

J. R. KANTOR

UNIVERSITY OF CHICAGO

A SIDEWALK MIRAGE

TO THE EDITOR OF SCIENCE: It seems the phenomenon here described must have been noticed by many others, but it caught my attention for the first time about two weeks since, and nowhere have I seen it described.

On several occasions, lately, I have observed a mirage under the conditions hereafter stated which are those of a typical case. I was walking eastward on a cement sidewalk on a street running nearly east and west, and moving up a moderate grade which joins a nearly level stretch of walk. On reaching a point which brought my eye slightly above the level portion, and at which normally the level stretch would have been seen in its entire length, but much foreshortened, I observed instead what appeared to be a stretch of clear dark water covering the entire width of the walk, and brilliantly reflecting moving persons and other objects in sight beyond it.

The sky was clear, the air cool, the sun high. It was about three o'clock P.M., local time. There was a moderate breeze. The angle of observation was very small, probably not above three degrees. A step or two either east or west, and the water was gone, but within the proper limits, the illusion was definite and continuing. The Weather Bureau report for the day indicates that approximately 30 feet above the spot where the mirage was observed the air temperature was about 63° F. and the humidity about 63°.

The resemblance between conditions here described and those which produce the mirage on the plains is obvious.

F. W. MCNAIR

MICHIGAN COLLEGE OF MINES

SCIENTIFIC BOOKS

Helmets and Body Armor in Modern Warfare. By BASHFORD DEAN. New Haven, Yale University Press.

To most of us armor belongs to the romantic past. We hardly think of it as a practical, up-to-date accessory of modern warfare. But in a book which has recently appeared, it is clearly demonstrated that armor has still a distinct value. We are of course familiar with the various steel helmets used by all the nations in the Great War, but it is not generally known that all the countries were hard at work experimenting with and developing body armor of every sort for their fighting men. General Pershing recognized its value and in the title page of Dr. Bashford Dean's "Helmets and Body Armor in Modern Warfare" he is quoted as saying that "effort should be continued towards a satisfactory form of body armor."

Dr. Dean is the foremost authority on armor in this country and curator of arms at the Metropolitan Museum of Art. When we entered the war he was placed in charge of the armor problem and his tireless energy and enthusiasm, together with the generous cooperation of the Metropolitan Museum, led to the development of many types of armor for our combat troops. It is unfortunate that too little of this armor was used during the final drive of 1918.

Dr. Dean views the subject from many angles. The introduction is devoted to the evolution of modern armor from early times and enables one to contrast the old with the new. The medical viewpoint is considered

with statistics showing the frequency of wounds in certain locations and its bearing on the armor problem.

The utilitarian side is shown and the advantages and disadvantages are carefully weighed. Of interest to metallurgists are tables showing the ballistic values of various metals used for armor and one interesting chapter is devoted to the subject of "yielding" armor, such as padded cotton and silk fiber. Indeed the matter is viewed both from a distance and in minute detail.

The experimental types of armor of all countries are shown and reasons given for their success or failure.

Dr. Dean's summary and conclusions are of particular interest. He believes that we have not as yet solved the problem of providing the best alloy for armor and that the end, as far as the improvement of thin plate for ballistic use, is not yet in sight.

The old struggle between bullet-proof armor and armor-piercing bullets is still on, although at the present time the armor seems to have the advantage.

The question of the best form of the American helmet is also considered. At present we are still using the British helmet and American experts agree that this model does not give sufficient protection to the back and sides of the head. Moreover, a national type should be adopted.

The question as to whether armor will be used in the future hinges not a little on the problem of getting transports to the front. The infantry-man carries a maximum necessary load without his armor which would therefore have to be sent up to him.

Considerable prejudice among the men also accounts for the unpopularity of armor—they do not wish to be burdened with it and would rather take the chances on being hit. But as the author puts it, if they can be made to see that it is really worth while, this prejudice may be overcome.

Dr. Dean, from his careful study of ancient armor and his practical knowledge of modern conditions, is qualified to speak with authority on the subject. In designing the modern helmets, a comparative study was made of the more ancient ones in the Armor Hall of the Metropolitan Museum of Art. Diagrams showing the development of armor were used and every type of helmet used with success in the past was carefully studied. If it seemed practical, a modern adaptation was designed and beaten out by hand. Due allowance was made in the design for its eventually being pressed out in millions by modern machinery. By this common-sense method Dr. Dean was able, in a comparatively short time, to weed out the impractical forms and to develop a modern type of armor made by machinery for modern warfare.

Who can say, but what it may not yet be used?

Dwight Franklin

SPECIAL ARTICLES

DECOMPOSITION OF HYDROGEN PEROXIDE BY ORGANIC COMPOUNDS AND ITS BEARING ON THE CATALASE REACTION

The last few years have witnessed a revival of unusual interest in the oxidizing enzymes and more particularly in catalase. The catalase reaction derives its interest from the fact that according to recent interpretations it is supposed to be a measure of the metabolic function of living matter. This view, entertained some twenty-odd years ago by Spitzer,[1] has been given much currency in late years by Burge whose numerous contributions to this topic are well known.

Considering the process of intracellular oxidation which is still very obscure it is possible to recognize three factors or enzymes involved in some way or other in the reaction. Of these the oxidases affect the oxidation of easily oxidizable substances directly; the peroxidases accomplish this indirectly by activating part of the oxygen of peroxides; lastly, the catalases by decomposing peroxides liberate inactive or molecular oxygen. It was in this sense that Loew[2] employed the designation "catalase" for the enzyme which may ultimately turn out to have no relation to the

1 Spitzer, *Arch. ges. Physiol.*, 67, 615–656, 1897.

2 Loew, Report 68, U. S. Department of Agriculture, 1901.

oxidation of organic substances. The occurrence of catalase is so general in plant and animal tissues that its existence certainly must have a significance. Loew conceived the idea that peroxides are formed in the cells in the process of respiration, and that the catalase saves the protoplasm from being injured by these peroxides by decomposing them as fast as they are being formed. Usher and Priestly[3] have shown that in plants at any rate hydrogen peroxide is actually one of the substances formed under the action of light and, if not immediately destroyed by catalase, will bleach the chlorophyl and thus interfere with the photosynthetic reaction. In the last few years the work of Appleman, Zaleski and Rosenberg, Loevenhart and Kastle, Alvarez and Starkweather, McArthur and notably of Burge have drawn attention to the probable function of catalase as an index of metabolic activity. Our interest in catalase originated with this fundamental problem of the relation of catalase to tissue metabolism. It may be mentioned that since our research has been in progress a number of papers appeared by Becht,[4] Stehle,[5] Reimann and Becher[6] which not merely challenge the interpretation which Burge and others place on catalases, but also their experimental findings.

The observations of which this is a preliminary report, although not bearing directly upon the fundamental problem of the catalase function, throw nevertheless interesting light on the subject. The literature contains many instances of inorganic substances, such as colloidal platinum and several others which possess remarkable catalytic power, and bring about reactions characteristic of enzymes. Thus Sjolleman[7] found that colloidal manganous oxide gives all the typical reactions for oxidases. Again Wolff[8] showed that certain iron salts can play the part of peroxidases, while Bredig's[9] "inorganic ferment"—a colloidal platinum—is capable of decomposing hydrogen peroxide as vigorously as catalase. There is, however, no record of organic substances simulating a biological process. We have discovered a group of aromatic hydrocarbons and their derivatives which give the typical catalase reaction. Such substances may undoubtedly help to throw light on the chemical structure and characteristics of the enzyme itself.

Our numerous experiments which we will report in detail later arose from the accidental observation that an enzyme preparation preserved with toluol had acquired a remarkably increased capacity for decomposing hydrogen peroxide. It was at that time also that a paper appeared by Euler and Blix[10] on yeast catalase in which these authors state that the catalase is activated by several substances, toluol among them. The idea of an activation of the enzyme by toluol seemed entirely improbable from our experience, because we found that even such minute quantities of toluol as 0.05 or 0.1 ccm. can decompose hydrogen peroxide. We undertook therefore to examine a number of related organic compounds in the hope of finding whether this non specific catalase reaction is in any way associated with the chemical structure of the organic catalysts. Starting with benzene we studied a number of its homologues and some of its derivatives. Benzene was found to react most vigorously, 0.2 ccm. liberating about 20 ccm. of oxygen from hydrogen peroxide in a manner so closely resembling the effect of an active enzyme preparation that one could not tell the difference unless informed as to the material used in the test.

The aromatic hydrocarbons of the benzene group form a series according to the number of methyl radicles attached to the ring with a gradually decreasing power to decompose hydrogen peroxide, thus:

Benzene > Toluol > Xylol > Mesitylene

[3] Usher and Priestly, *Proc. Roy. Soc. London*, 77B, 369, 1906.

[4] Becht, *Am. J. Physiol.*, 48, 171–191, 1919.

[5] Stehle, *J. Biol. Chem.*, 39, 403, 1919.

[6] Reimann and Becker, *Am. J. Physiol.*, 50, 54, 1919.

[7] Sjolleman, *Chem. Weeklad*, 6, 287–294, 1909.

[8] Wolff, *C. r. Ac. Sc.*, 146, 142–144, 781–783, 1908.

[9] Bredig, "Anorganische Fermente," 1901.

[10] Euler und Blix, *Ztschr. physiol. Chem.*, 105, 83–114, 1919.

The reaction is not general for the aromatic hydrocarbons, but is specific for those of the *benzene series*. Hydrocarbons with more than one benzene ring, like diphenyl and triphenyl methane, benzidine, naphthalene and anthracene all proved to be inert. Heterocyclic compounds also gave negative results.

We mentioned already that the increase in the number of methyl groups in the benzene ring results in a corresponding decrease of the catalytic activity of the compound. The introduction into the ring of a carboxyl group, an $NHNH_2$ group or of phenol groups renders the hydrocarbon incapable of decomposing hydrogen peroxide. On the other hand, the presence of nitro, amino and aldehyde groups, or of a halogen atom does not prevent the compound from breaking up of hydrogen peroxide, though its power is much less than that of the unsubstituted hydrocarbon. Aniline, nitrobenzene, benzaldehyde and chlorbenzene decompose hydrogen peroxide, but dichlorbenzene, benzylchloride or benzoylchloride, were found inactive. Adrenalin, both the base and the hydrochloride, decompose hydrogen peroxide though very feebly.

A more detailed discussion of the catalase-like reaction of benzene and its homologues is reserved for the near future. Suffice it to say that we have satisfied ourselves that this decomposition is not caused by changes in surface tension.

Sergius Morgulis,
Victor E. Levine
Creighton Medical College

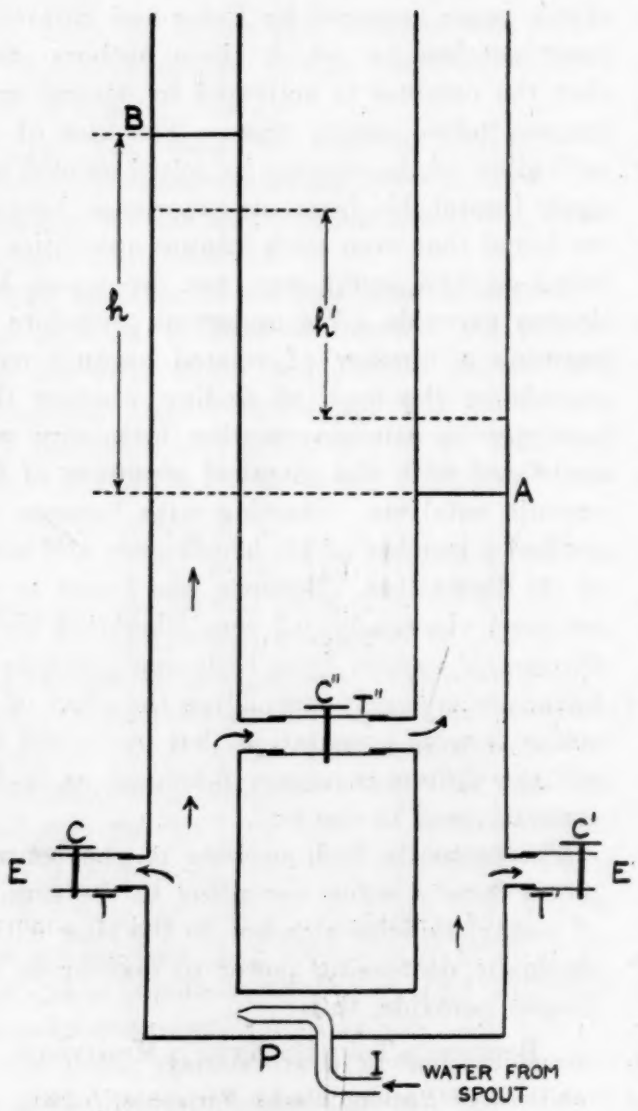


Fig. 1.

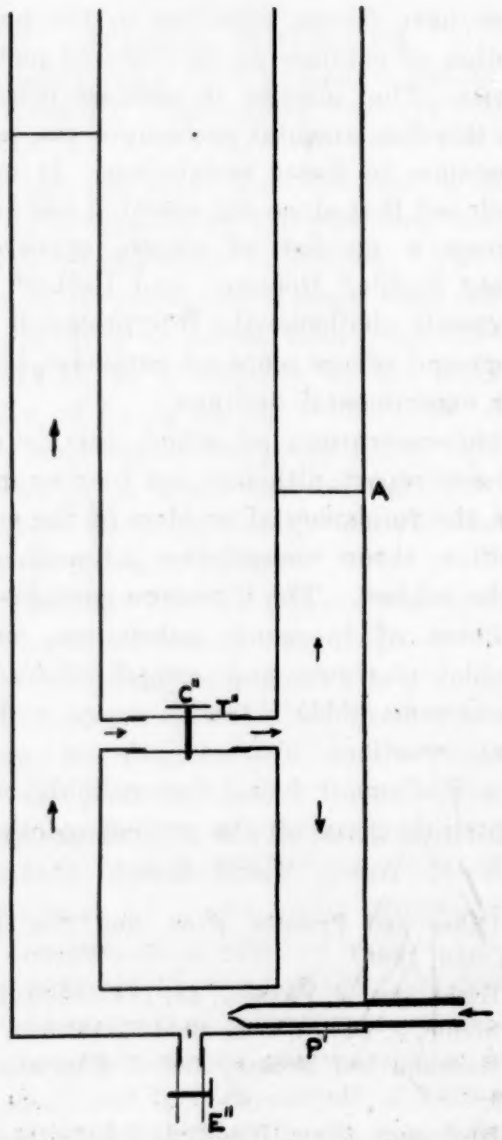


Fig. 2.

A SIMPLE DEVICE FOR SHOWING BY A HYDRAULIC ANALOGUE THE EFFECT PRODUCED ON THE POTENTIAL DIFFERENCE BETWEEN THE TERMINALS OF AN ELECTRIC CELL WHEN THE CIRCUIT IS CLOSED

THE Lodge theoretical paddle wheel device shown by Professor Kimball in Figs. 336 and 337 of his "College Physics" (ed. 1917) suggested to the writer an arrangement which would render possible an actual lecture demonstration.

Into the glass U-tube of Fig. 1 a stream of water is injected at P. The water is removed at the exits E and E', the sizes of which may be controlled by adjustable pinchcocks C and C' on the rubber tubes T and T'. The "current" is controlled by the pinchcock C'' or one's fingers on the rubber tube $T.''$ The inflow at I may be controlled by the faucet to which the apparatus is attached. When C'' is closed, h represents the potential difference on open circuit. Upon opening $C,''$ level B falls and A rises: $h' < h$ or the potential difference decreases when the circuit is closed.

My friend, Professor F. A. Saunders, has modified the arrangement by placing the water-spout at P' (Fig 2). This is an improvement from the pedagogic standpoint as the source of gross energy in an electric cell lies at the surface of separation between one plate and the electrolyte. He also suggests removing the injected water at but one point, E'' (Fig. 2).

NORTON A. KENT

PHYSICAL LABORATORY,
BOSTON UNIVERSITY

THE AMERICAN METEOROLOGICAL SOCIETY

THE second meeting of the American Meteorological Society was held at the Weather Bureau, Washington, D. C., on April 22, 1920. The attendance was 40 to 50 at each of the two sessions, held in the morning and in the evening. Professor C. F. Marvin, chief of the U. S. Weather Bureau gave a short address of welcome, which was followed by a program of 15 papers. Brief synopses of the papers and discussions were published in the society's bulletin for May, 1920 (pp. 48–55); and the papers themselves or authors' abstracts are still appearing in the *Monthly Weather Review* (issue shown in parentheses). The program was as follows:

**Temperature scales and thermometer scales:* E. W. WOOLARD. (May.)

Shall we adopt a half-degree absolute centigrade scale instead of the Fahrenheit? CHARLES F. MARVIN. (Not published.)

The physics of the aurora: W. J. HUMPHREYS. (Abstract to be published.)

**The auroras of March 22–25, 1920:* HERBERT LYMAN. (July (?).)

The most intense rainfall on record: B. C. KADEL. (May.)

**New aerological apparatus:* S. P. FERGUSON. (June.)

Temperatures versus pressures as determinants of winds aloft: W. R. GREGG. (Abstract, May.)

**Daily wind charts for stated levels:* C. LEROY MEISINGER. (May.)

Cloud base altitudes as shown by disappearance of balloons and kites: O. L. LEWIS. (July (?).)

**Cloud nomenclature:* CHARLES F. BROOKS. (July(?).)

**Some meteorological observations of a bombing pilot in France:* THOMAS R. REED. (April.)

Project for local forecast studies: R. H. WEIGHTMAN. (March.) (By title.)

Climatic conditions in a greenhouse as measured by plant growth: EARL S. JOHNSTON. (Abstract, April.)

Modifying factors in effective temperature: ANDREW D. HOPKINS. (April.)

Relation of rainfall to the grazing capacity of ranges: J. WARREN SMITH. (June.)

Separates have been or are to be made of those starred, and may be obtained from the U. S. Weather Bureau, Washington, D. C.

The American Meteorological Society, the project of which was announced in SCIENCE, just a year ago (August 22, 1919, pp. 180–181), and of which progress was reported (December 12, 1919, pp. 546–547) and organization in December announced (March 12, 1920, pp. 275–276), has grown with unexpected rapidity to a membership of nearly 1,000. Plans are being made for the organization of a Brazilian division of the society, and it is probable that a Pacific division will be organized when the Pacific section of the American Association for the Advancement of Science meets next summer.

The next meeting will be held in Convocation Week, December, 1920, at Chicago.

CHARLES F. BROOKS,
Secretary

WEATHER BUREAU,
WASHINGTON, D. C.

THE AMERICAN CHEMICAL SOCIETY. III

The Kaufler-Cain formula for diphenyl derivatives: OLIVER KAMM and C. S. PALMER.

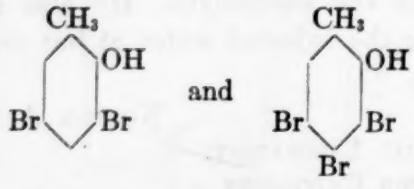
BB'-dichlorodiethyl ether: the oxygen analogue of mustard gas: OLIVER KAMM and J. H. WALDO.

The chlorination of acetone: A. W. HOMBERGER and M. BORRIES. Technical acetone was purified and treated with dry chlorine in sunlight. During the chlorination three distinct steps were noted. The first step was completed at the close of the first half hour. No hydrochloric acid was liberated during this stage. The second step lasted two hours. The heat of reaction was much higher than in the preceding step and whenever the temperature rose over 80 degrees violent reaction, resulting in flames, took place. A third step took place after this second reaction with no violent action and a temperature maintained itself below 80 degrees, and no tendency to burst into flames. During the second and third step hydrochloric acid was liberated, much more during the second than the third step. The resulting liquid of chlorination was submitted to distillation under diminished pressure and three distinct fractions obtained. The three fractions, when redistilled, showed definite and well-defined boiling points and properties. Each of these products is being investigated at present.

The use of a chart in the study of organic chemistry: CHAS. W. CUNO. The studies are divided into three great divisions, the memory studies, the reasoning studies, and the constructive studies. The two great memory studies are history and the languages. History concerns itself with data and dates, or to put it abstractly, with sequence and facts. Language concerns itself with interpretation. If we examine the reasoning studies such as chemistry we find they have a language and sequence and data that need to be made a part of the memory before the student can very well reason intelligently. In organic chemistry the language is exceedingly difficult and the data and sequence very voluminous. The use of a chart such as the one published by the author has its use, therefore, to help the student in acquiring the data, sequence and language of organic chemistry.

The mechanism of some reactions involving the Grignard reagent: HENRY GILMAN. It has been conclusively proved that the reactions of ketenes are not restricted to primary addition to the ethylenic linkage. The benzoate of triphenyl-vinyl-alcohol was obtained when the addition compound of diphenyl ketene and phenyl magnesium bromide was treated with benzoyl chloride. The Grignard reagent, therefore, has added to the carbonyl group. Preliminary experiments on the mode of reaction of the Grignard reagent and phenyl isocyanate (and phenyl iso-thiocyanate), indicate the following: first, but one molecule of phenyl magnesium bromide adds; second, addition takes place on the carbonyl (and thio-carbonyl) linkage; and, third, addition is probably restricted to this linkage, as with the ketenes.

The nitration of certain halogenated phenols: L. CHAS. RAIFORD. In preparing halogenated o-aminophenols with which to test further the migration of acyl from nitrogen to oxygen (*J. A. C. S.*, 41, 2068 (1919)), several of the brominated cresols were nitrated according to the method used by Zincke (*J. pr. Chem.* (2), 61, 561 (1900)), who found that in the meta series the halogen atom para to hydroxyl was replaced by the nitro group, while in the ortho and para series the atom ortho to hydroxyl was replaced. In none of these cases did he report the formation of isomeric nitro compounds in a single experiment. In the present work it has been found that the dibromo and tribromo-ortho cresols, to which Zincke has assigned the structures



both give isomers when they are nitrated as indicated above. The structures of the isomers, as well as the mother substances, are under consideration.

Action of aromatic alcohols on phenols in the presence of aluminum chloride: RALPH C. HUSTON. Earlier work has shown that aromatic alcohols (primary or secondary) are readily condensed with aromatic hydrocarbons such as benzene, toluene, etc., to form diphenyl methane or derivatives thereof. In the present work benzyl alcohol was allowed to react at relatively low temperatures with phenol in

the presence of Al Cl_3. A good yield (40–50 per cent.) of *p* benzyl phenol was obtained, according to the equation

$$C_6H_5CH_2OH + C_6H_5OH \xrightarrow{AlCl_3} C_6H_5CH_2C_6H_4OH + H_{20}.$$

Slightly better yields of the ethers of this phenol were obtained by the condensation of benzyl alcohol with anisol or phenetol.

Derivatives of cyclohexane: ARNOLD E. OSTERBERG and E. C. KENDALL.

The formation of organic reactions under the electron conception of valence, reaction of formaldehyde: H. C. P. WEBER.

A new color reaction for phenols based upon the use of selenious acid: VICTOR E. LEVINE. Phenols in contact with a solution of 0.5 per cent. selenium dioxide or 0.75 per cent. sodium selenite in concentrated sulphuric acid give rise to a pale green, olive green, emerald green, blue-green or purplish blue color. Often several colors are observed simultaneously. On standing, on heating or on the addition of water the characteristic color or play of colors disappears, giving way to a dark brown, reddish brown or brick red. The reactions is of great sensitivity and of wide applicability. The following types of phenols respond to the test: Mono-, di- and triphenols, phenolic ethers, aldehydes, alcohols and acids, glycosides yielding phenols on hydrolyses, dyes and alkaloids possessing phenolic groups. Nitrating the phenol abolishes the reaction, for *o*-nitrophenol, *p*-nitrophenol, di- and trinitrophenol yield negative results. Phenolic aldehydes and acids give extremely faint reactions. The following compounds tested prove the general value of the reaction: phenol, amidol, anisole, phenetole, phenacetine, the cresols, salicylic aldehyde, salicylic acid, acetyl salicylic acid, methyl and phenyl salicylates; pyrocatechol, guaiacol, vanilin, vanillic acid, piperonal, resorcin, hydroquinone, pyrogallol, phloroglucine; eugenol, thymol, carvacrol, α- and β-naphthol, chrysarobin; the glucosides, arbutin, phloridzin; the opium alkaloids, morphin, heroin, dionin, narcotine, narceine, papaverin; the dyes, orcein, alizarin, purpurin. The reaction proves very useful in detecting phenols in solid or liquid state. Phenols dissolved in water or in an organic solvent should first be evaporated in a porcelain crucible and the test made on the dry residue. A beautiful ring test may be obtained by the addition of a chloroform or amyl alcohol solution of the phenol to the selenium reagent. A bright emerald green is observed at the point of junction of the two liquids. The green compound remains with the sulphuric acid and does not dissolve in the organic liquid. The course of the reaction may be explained on the ground that the phenol decomposes the selenous acid with the formation of free selenium. This dissolves with a green color in concentrated sulphuric acid to form selenosulphur trioxide.

A note on the differentiation of acetic anhydride from glacial acetic acid: VICTOR E. LEVINE. A differentiation based upon chemical tests may be made as follows: (1) A few drops of 0.5 per cent. selenium dioxide in concentrated sulphuric acid added to acetic anhydride results in the formation of elemental selenium, which appears as brick-red colloidal solution or precipitate. Glacial acetic acid is not affected by the selenious acid reagent. (2) Ten drops of acetic anhydride are shaken with 2 c.c. chloroform in which a few crystals of cholesterol have been dissolved. On the addition of 20 drops of concentrated sulphuric acid a fleeting purple is developed changing to blue and finally to deep green. With or without glacial acetic acid a lemon yellow color forms, which quickly goes over to deep orange, cherry red or burgundy red.

The poly-phenyl ethers: HILTON IRA JONES.

The decomposition of amines at high temperatures: FRED W. UPSON.

Oxalyl chloride in the synthesis of the triphenylmethane dyes: HARPER F. ZOLLER. Oxalyl chloride may be used in the place of phosgene or Michle's ketone in the condensing of aniline and its derivatives for the production of dye stuffs of the magenta type. The use of fused zinc chloride increases the yield of the colored base just as was found true in the case of phosgene. The calculated molecular quantities of aniline or its derivatives are mixed with a corresponding amount of oxalyl chloride necessary to produce a given dye. This mixture is heated in a flask bearing a reflux condenser and suspended in a hot water bath. Crystal violet (hexa methyl tri amino triphenylmethane) para rosaniline (tri amino triphenylmethane) have been prepared using oxalyl chloride in their synthesis. No accurate study has been made of the yields of the dyes using these synthesis. The quantity obtained using the above method amounted to about 50 per cent. of the theoretical. The synthesis is described as a very convenient laboratory method of producing the dyes in small and very pure quantities.

The benzoic acid ester of trichlorotertiary butyl-alcohol or chloretone benzoic acid ester: T. B.

ALDRICH. The benzoic acid ester of chloretone is prepared by heating molecular quantities of anhydrous chloretone and benzoyl chloride (slight excess) on the steam bath, until hydrochloric acid gas ceases to be given off. Any uncombined chloretone or benzoylchloride is eliminated and the resulting body recrystallized from alcohol. The ester is when pure a solid melting at 34°–35° and *not a liquid* as claimed by Willgerodt and Durr (*J. f. praktische Chemie* (Neue Folge), 39 and 40, p. 189). It may be distilled under reduced pressure without decomposition. Chlorine determinations (Carius) gave results which characterize the compound as the benzoic ester:

$$C_6H_5CO—OCC_2H_3Cl_3.$$

The compound is readily soluble in the organic solvents, and practically insoluble in water. It is not readily saponified, being much more stable than the other esters studied. Boiling with con. nitric acid does not decompose it as is the case with the aliphate esters of both chloretone and brometone. It is not volatile in the air, but is slightly volatile with steam. Pharmacological tests would indicate that it possesses less hypnotic and anesthetic properties and is less toxic than the esters studied thus far. Its relative stability is greater than that of any of the esters studied previously.

The utilization of waste silk fibroin: TREAT B. JOHNSON and P. G. DASCHAVSKY. A statistical study of the development of the waste silk industry in the United States. The behavior of fibroin on distillation is described, and an improved method of obtaining tyrosine from fibroin has been developed. It is shown experimentally that fibroin is a valuable source of the drug "tyramine," $HO \cdot C_6H_4 \cdot CH_2CH_2NH_2$.

The conversion of anilides of chloracetic acid into ketide-isothiocyanates: TREAT B. JOHNSON, ARTHUR J. HILL and ERWIN B. KELSEY. Isothiocyanates of the general formula

$$SCN \cdot CH_2 \cdot CONHR$$

have hitherto never been synthesized. A method of preparation has now been developed which eliminates any possibility of the formation of isomeric rhodanides $NCS \cdot CH_2CONHR$. The work is an extension of earlier researches on thiocyanates and isothiocyanates carried on in the Sheffield Chemical Laboratory, and has led to the development of a new method of entering the hydantoin series.

The condensation of formaldehyde with o-nitrophenol: TREAT B. JOHNSON and J. B. HISHMAN. A repetition of the work of several previous investigators has revealed the fact that *o*-nitrophenol condenses with formaldehyde to form two isomeric compounds, viz.: 3-nitro-4-hydroxy- and 3-nitro-2-hydroxybenzylalcohols. Several new derivatives of these compounds have been prepared.

The alkylation of aromatic amines by heating with alcohols: ARTHUR J. HILL and J. J. DONLEAVY. A study of the influence of catalysts on the general reactions

$$R \cdot NH_2 + R'CH_2OH \rightarrow R \cdot NH \cdot R' + N_2O$$

and

$$RNH_2 + 2R'CH_2OH \rightarrow R \cdot N(R')_2 \cdot + 2H_2O.$$

The work so far has been confined to the study of aniline and the isomeric toluidines and the two alcohols ethyl and *n*-butyl. It has been found by experiment that these alkylation reactions are greatly stimulated by using certain inorganic salts as catalytic agents. The first contribution on this subject has already been accepted for publication in the *Journal of Industrial and Engineering Chemistry.*

The search for pressor substances in the pyrimidine series: TREAT B. JOHNSON and L. A. MIKESKA. A study of some new amidine condensations leading to the formation of new types of cyclic amine combinations in the pyrimidine series. The substances under examination will be submitted to a careful pharmacological investigation to determine their pressor or other specific action. The research will be extended to the hydantoin and purine series.

The oxidation of iso-propyl alcohol by means of alkaline potassium permanganate: WM. L. EVANS and LILY BELL SEFTON.

CHARLES L. PARSONS,
Secretary

(To be continued)

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